“Chemical Modification of Natural Polymer for Pharmaceutical Applications”

A SYNOPSIS

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01. ABSTRACT OF PROPOSED WORK PLAN / PROBLEM

Natural Polymers play an important role as excipients in pharmaceutical dosage form. They influence drug release and should be compatible, non-toxic, stable, economic etc. Natural Polymer basically polysaccharides. They are biocompatible and without any side effects. Polymeric materials plays different roles such as binders, matrix formers, drug release modifiers, film coating formers, thickeners or viscosity enhancers, stabilizers, suspending agents , gelling agents and bioadhesives. Polymer possesses a number of reactive functional groups in their structure such as hydroxyl, amino and carboxylic acid group which are responsible for chemical modifications. The aim of proposed work is to chemically modify natural polymer from Polysaccharide class such as pectin, chitosan, tamarind gum for betterment in physicochemical properties of polymer which overcome the shortcomings associated the use of natural polymer. The characterization of modified can be done by using suitable methods. The modified polymer is used for new drug delivery design. The in vivo and in vitro evaluation study can be carried out.

02 INTRODUCTION :-

A polymer is a large molecule, or macromolecule, composed of many repeated subunits. Synthetic and natural polymers play essential roles in everyday life. The pharmaceutical applications of polymer range from their use as binders in tablets to viscosity and flow controlling agents in liquids, suspensions and emulsions.

Synthetic Polymer :-

Many commercially important polymers are synthesized by chemical modification of naturally occurring polymers (1). Advantage of synthetic polymer is high level control over chemical and mechanical properties and integration of bioactive compounds in the matrix. Limitations of synthetic polymers are non-biodegradable and easily breakables.

Natural Polymer :-

Natural biopolymer such as starch, pectin, chitosan and gelatin have found use in industries as diverse as food, textiles, cosmetics, plastics, adhesives papers and pharmaceuticals. Polymers have been successfully employed in the formulation of solid, liquid and semi-solid dosage forms and are specifically useful in the design of modified release drug delivery systems. Both natural and synthetic polymers have been investigated extensively for this purpose, but the use of natural polymers for pharmaceutical applications is attractive because they are economical, readily available, non-toxic and capable of chemical modifications, potentially biodegradable and with few exceptions also biocompatible. Furthermore, they can be modified to obtain tailor made materials for drug delivery systems allowing them to compete with the synthetic products that are commercially available (2).

Chemical modification of Natural Polymer such as Pectin , Chitosan, Tamarind gum(4), alginate, gelatin has been done by different chemical methods. Polymer can be chemically modified by acetylation , saponification. catalyzed by mineral acids, bases, salts of weak acids, enzymes, concentrated ammonium systems and primary aliphatic amines .

03 REVIEW OF LITERATURES AND DEVELOPMENT IN THE SUBJECT :-

Polysaccharide hydrogels were used in oral drug delivery devices for a more effective release of active agents in the colon . Colonic delivery overcomes hurdles such as poor drug stability in the small intestine or poor transport across biological membranes in the upper gastrointestinal tract. Direct drug delivery to the colon was also more effective in the case of diseases such as ulcerative colitis, colorectal cancer and Crohn's disease They had encapsulated active agents, such as proteins, antibiotics, nucleotides, etc, in high cross linked pectin polymeric beads allowing their direct administration to the colon (2) .

The chemical modification of pectin by limited acetylation of their free hydroxyl groups to yield high ester pectin and investigated its swelling and erosion behavior along with the effect on the release pattern of drugs had been reported(3). Propranolol as an antihypertensive drug was formulated as tablet using chemically modified pectin and pure pectin by using wet granulation method and its collision on drug release was studied(4). Physicochemical characterization of chemically modified pectin, the solubility, gelling or swelling factor was studied (5).

Polymers had become an integral part of drug delivery systems due to their improved pharmacokinetic properties. They had better circulation time than conventional small drug molecules thus target tissue more specifically. Tremendous use of polymers had been witnessed in the area of polymer therapeutics and Nano medicines. Solvent activated systems like hydrogels swell and release the drug when exposed to aqueous environment. Polymers mimicking biological systems respond to external stimulus such change in pH or temperature and as a result their properties such as solubility, hydrophobic/ hydrophilic balance, release of biomolecule (drug molecule) and conformation are altered (6).

	The synthesis and characterization of nano formulations (NFs) PLGA (poly lactic-co-glycolic acid) by surface modification and polymer nanoparticles as vehicles were used for delivery of hydrophobic anti-cancer drugs, like doxorubicin, paclitaxel or chemopreventors like quercetin (Q). Surface modification in NFs is evidenced by three distinct regions in their TEM images; the core, polymer capsule and the coated surface (7). Pectin (PEC) was used as carrier material and doxorubicin (DOX) as a model drug, the blank PEC nanoparticles (PEC-NPs) and the DOX-loading PEC nanoparticles (DOX-PEC-NPs) were prepared by micro emulsification method. They have investigated the anticancer activity of DOX-PEC-NPs in vitro to understand the advantages of PEC-NPs as an anticancer drug delivery system (8). Pectin is suitable for use as colon-specific drug delivery vehicle as it is selectively digested by colonic microflora to release drug with minimal degradation in upper gastrointestinal tract. The review suggested that multi-particulate calcium pectinate matrix is an ideal carrier to orally deliver drugs for site-specific treatment of colon cancer. Pectin matrix demonstrates dual advantages as drug carrier and therapeutic for use in treatment of colon cancer (9). The mentioned review of literature revealed that Natural Polymers serving as excellent drug carrier , water soluble, nontoxic and non-immunogenic. They work passively in minimizing drug degradation and improving circulation time. Hence the chemical modification of polymer of polysaccharide such as pectin, chitosan, gelatin, tamarind gum etc will be most required area for future research.

04. Objectives of Research / Proposed Hypothesis :-

1. The main objective of this proposed investigation is to chemically modify the natural polymer from Polysaccharide class such as pectin, chitosan, tamarind gum, gelatin, alginate to better improvement in biochemical / physicochemical properties.
2. Characterization of modified polymer.
3. Design of drug delivery.
4. Evaluation by In vivo & In vitro study

05. Materials and Methods (Methodology to be adopted) :-

1. Chemical Modification of Natural Polymer by using different chemical methods Acetylation, saponification, catalyzed by mineral acids, bases, salts of weak acids, enzymes.
2. Characterization of Modified Polymer by solubility studies, Gelling or swelling factor, Determination of Acid value, saponification value, UV, FTIR, X-ray diffraction.
3. Design of Drug Delivery-

   A novel drug such as Ibuprofen, Acelofenac is designed by using modified polymer.
4. Evaluations by In Vitro and In Vivo Study – Drug Release study, Dissolution study.

06. Importance of study / Society application:-

Chemical modification of natural polymers has become a vibrant field of research on account of great rationales which stimulated numerous efforts. Natural Polymer has number of advantages even though they have not been fully exploited. Hence chemical modification of natural polymer is major area of research having many pharmaceutical applications. Polymers are being used extensively in drug delivery due to their surface and bulk properties. They are being used in drug formulations and in drug delivery devices.

International status:-

Over the past 20 years, the polymer and ailed industries have focused on synthetic Polymers and limited to moderate level of efforts were directed towards modification of natural polymers. With the new interests in the biomedical and pharmaceutical industries, chemical modification of natural polymer to meet the growing needs are being recognized.

National status :-

Chemical modification of polymer can be used in food, leather, paper and textile industries and mainly in Cosmetics and pharmaceutical industries.

Significance of the study:-

Chemical modification of polymers provided the opportunity to explore beyond conventional drug delivery. A thorough understanding of the polymer and its chemical modification has a huge potential to be the future trend for drug delivery and has many pharmaceutical applications.

07. PROPOSED WORK PLAN / DURATION OF WORK :-

Sr. No.	WORK	PERIOD
1	Literature Survey	6 Months
2	Procurement and selection of Polymer / drug formulations	2 Months
3	Chemical Modification of Polymer	9 Months
4	Characterization of modified Polymer	3 Months
5	Formulation of drug with modified polymer	6 Months
6	Evaluation by In vitro & In Vivo study	6 Months
7	Publishing Research and submitting data	4 Months
	Total duration of project	**36 Months**

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